QA: QA

Bechtel SAIC Company, LLC

Technical Work Plan For:

Meteorological Monitoring and Data Analysis

TWP-MGR-MM-000001

Revision 2

Work Package: Y58505 Air Quality / Meteorology

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REVISION HISTORY

Revision Number	Date of Revision	Purpose of the Revision
00	10/01/2000	Initial issue
0A		Detail on the Meteorological Monitoring Program
0B		FY2001 Activity Evaluation for WP#72012152N4(A) – Meteorology, and WP#72012152N4(B) – M&TE
0C	03/08/2001	Revised FY2001 Activity Evaluation to include ISMQAP applicability evaluation with grading report
0D	01/04/02	Add new FY2002 Activity Evaluation and ISMQAP grading report
01	05/30/2002	Revision 1 issued to satisfy DR-BSC-02-D-095. Minor editorial changes were made
02	03/31/2003	Revised to comply with AP-2.27Q and to satisfy BSC(B)-03-D-076

ACRONYMS AND ABBREVIATIONS

BSC	Bechtel SAIC Company, LLC
DOE	U.S. Department of Energy
ES&H	Environmental Safety and Health
IAM	Information and Analysis Management
M&TE	measuring and test equipment
TDMS	Technical Data Management System

1. Work Scope

The meteorological monitoring and analysis program has three overall objectives. First, the program will acquire qualified meteorological data from monitoring activities in the Environmental Safety and Health (ES&H) network, including appropriate controls on measuring and test equipment. All work will be completed in accordance with U.S. Department of Energy (DOE) Office of Repository Development (ORD) administrative procedures and Bechtel SAIC Co., LLC (BSC) line procedures. The continuously operating monitoring program includes measuring and test equipment calibrations, operational checks, preventive and corrective maintenance, and data collection. Second, the program will process the raw monitoring data collected in the field and submit technically reviewed, traceable data to the Technical Data Management System (TDMS) and the Records Processing Center. Third, reports containing analyses or calculations could be created to provide information to data requesters.

The BSC ES&H Department's Information and Analysis Management (IAM) group is responsible for this work, which is covered by Work Package Y58505, *Air Quality and Meteorology*.

Data from calendar-year periods are submitted to the TDMS to meet the schedule requirements of preclosure radiological safety analyses, engineering design of surface facilities, and performance assessment. If one inch of precipitation falls in a 24-hour period at Midway Valley Site 1, the occurrence is reported to Test Coordination Office within 60 hours (BSC 2003).

2. Scientific Approach and Technical Methods

The scientific approach for the design and operation of the program is to acquire meteorological data intended to satisfy information needs for atmospheric modeling, environmental monitoring, and weather-related design purposes. Modeling activities are not included in the scope of this plan. Data are being used for pre-closure safety analyses, engineering design, and the biosphere analyses.

The technical methods used to acquire the meteorological data are based on regulatory agency monitoring guidance and applicable standards. The numerical uncertainty associated with the information collected is expressed as the measurement tolerances that are taken from the guidance documents discussed in Sections 2.2 and 3. Details on the approach and methods follow in this section.

2.1 Scientific Approach

Meteorological monitoring guidance applicable in the complex terrain in the Yucca Mountain area states that site-specific data should be obtained from a network of stations rather than a single location (NRC 1987, p.2.3.2-2; ANSI/ANS-3.11-2000, p.7). The stations with a full range of meteorological parameters acquire data for the atmospheric dispersion and other purposes mentioned above. The remaining stations provide detailed information on the spatial distribution and temporal occurrence of precipitation events in the area. Details on the monitoring network are presented in Addendum A.

The monitoring work was designed to satisfy environmental monitoring requirements contained in DOE Order 5400.1. The line procedures are linked to the relevant portions of this order through the Standards/Requirements Identification Documents tracking matrices. On January 15, 2003, DOE Order 5400.1 was superceded by DOE Order 450.1, although the requirements of the previous order remain in effect until the transition is made.

The field measurements of meteorological conditions are processed using on-site data loggers into various mean, extreme, standard deviation, and total summaries using a range of time periods. Wind gusts occurring in a 3-second period are recorded, as are the extreme daily 1-minute average wind speed and temperature values. The main summaries of all measurements are made for 10-minute and 1-hour time periods, with some daily summary values recorded. In addition, quality control steps include identifying instantaneous extreme values to assist in identifying possible periods of malfunctioning equipment.

2.2 Technical Methods

The monitoring work is designed to satisfy nuclear and environmental regulatory requirements and guidance, and internal ORD requirements. Applicable line procedures are identified in Section 6. The field operations work is described in *Field Activities in Support of Meteorological Programs* (BSC 2003). The primary monitoring guidance documents are:

- **ANSI/ANS-3.11-2000**–*American National Standard for Determining Meteorological Information at Nuclear Facilities*. This standard covers topics such as instrumentation, siting monitoring locations, data handling, and quality assurance.

- **NRC Regulatory Guide 1.23**–*Meteorological Measurement Programs for Nuclear Power Plants (Safety Guide 23 Onsite Meteorological Programs)* (NRC 1972). This is the basic approved U.S. Nuclear Regulatory Commission guide for meteorological monitoring. The principles of this regulatory guide are incorporated into the meteorological monitoring program, but specific items are excluded because they are no longer practiced in the industry due to technology improvements.

- **Environmental Protection Agency Guidance Documents**–*Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA 2000). Detailed technical guidance from the U.S. Environmental Protection Agency on quality assurance applied to meteorological measurements, equipment installation, operations, and calibrations are included in these comprehensive documents.

3. Standards and Criteria

Applicable standards and criteria for accuracy, precision, and representativeness are discussed in this section.

3.1 Standards

The monitoring guidance and standards documents listed in Section 2 are the primary references used in performing the monitoring and data processing work. Some of the calibration methods,

instrument exposure requirements, and data recording methods are based on ASTM meteorological standard practices and test methods. These standards include:

- D5741: *Standard Practice for Characterizing Surface Wind Using a Wind Vane and Rotating Anemometer*
- D5096: *Standard Test Method for Determining the Performance of a Cup Anemometer or Propeller Anemometer*
- D5366: *Standard Test Method for Determining the Performance of a Wind Vane*
- D3631: *Standard Test Methods for Measuring Surface Atmospheric Pressure*
- D6176M: *Standard Practice for Measuring Surface Atmospheric Temperature with Electrical Resistance Temperature Sensors (Metric)*.

The monitoring program uses operating equipment to measure conditions and collect data, and test equipment to calibrate and check the operating equipment. The calibrations and checks are performed using standards that comply with AP-12.1Q, *Control of Measuring and Test Equipment and Calibration Standards*. The procedure requires that the calibration standards are either traceable to nationally recognized standards, such as the National Institute of Standards and Technology, or demonstrate justification for use of another standard.

3.2 Criteria

The meteorological monitoring program collects, analyzes, and reports information that is used in subsequent presentations and analyses. There are no specific criteria for precision of the meteorological measurements as there is no precision assessment being performed.

The accuracy criteria for the measurements are based on the regulatory guidance documents identified in Section 2. The criteria are expressed as acceptable tolerances on the difference values calculated during calibration and performance check quality control activities. These criteria are summarized in Table A-2.

One further accuracy assessment is accomplished with the semi-annual independent performance audits required by the U.S. Environmental Protection Agency regulatory monitoring guidance (EPA 2000). The audit produces results using equipment and staff different from those used during normal operations and maintenance activities.

Regulatory monitoring guidance specifies that the data be representative and complete. To be representative, the data should correctly describe the locations and conditions suitable for the intended purposes. The site locations are described in Addendum A. The distribution of sites in the monitoring network was based on the guidance documents listed in Section 2.2.

The completeness criterion is satisfied for most guidance when valid data are available from at least 90 percent of the monitoring period. The missing portions should not occur during long single periods or during likely critical conditions.

4. Implementing Documents

The Project procedures required to perform the work include, but are not limited to:

AP-2.14Q, *Review of Technical Products and Data*
AP-2.20Q, *Self-Assessments*
AP-2.27Q, *Planning for Science Activities*
AP-3.15Q, *Managing Technical Product Inputs*
AP-5.1Q, *Plan and Procedure Preparation, Review, and Approval*
AP-5.2Q, *Testing Work Packages*
AP-12.1Q, *Control of Measuring and Test Equipment and Calibration Standards*
AP-15.2Q, *Control of Nonconformances*
AP-15.3Q, *Control of Technical Products*
AP-16.1Q, *Management of Conditions Adverse to Quality*
AP-ESH-004, *Occupational Safety and Health Program*
AP-OM-009Q, *Site Access Control*
AP-PMC-009, *Requesting Offsite Affiliate Services*
AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*
AP-SV.1Q, *Control of the Electronic Management of Information*
FWP-SB-99-001, *Field Activities in Support of Meteorological Programs*
LP-MM-001Q-M&O, *Tests and Checks of Meteorological Measuring and Test Equipment*
LP-MM-002Q-M&O, *Test, Checks, and Performance Audits of Meteorological Equipment*
LP-MM-003Q-M&O, *Routine Operations and Maintenance of Meteorological Equipment*
LP-MM-004Q-M&O, *Meteorological Data Processing*
LP-CAL-004Q-M&O *Analytical Balance Calibration*

5. Equipment

Suitable meteorological monitoring equipment is procured, installed, and operated for the conditions occurring on and around Yucca Mountain. The site locations and equipment used in the measurements are described in Addendum A.

The line procedures implement the equipment controls contained in AP-12.1Q. Some of the calibration standards and operational monitoring equipment are calibrated by ES&H/IAM staff following LP-MM-001Q and LP-MM-002Q, respectively. Other equipment, such as the wind sensors and some electronic measuring and test equipment (M&TE) is calibrated by outside vendors. Virtually all M&TE and operating equipment have a one-year calibration period, although equipment may be stored for three years prior to activating the calibration period.

6. Records

Records generated by work associated with this plan include the documentation of field monitoring activities produced by the specific line procedures governing that portion of the work. The work includes routine operations and maintenance, calibrations and checks, and data processing tasks. The technical product resulting from the monitoring work includes data submittals to the TDMS and the Records Processing Center.

7. Quality Verifications

No additional quality verifications, other than routine audits and surveillance, are required during the execution of these tasks. The ES&H organization performs self-assessments in accordance with AP-2.20Q, *Self-Assessments*.

8. Prerequisites, Special Controls, Environmental Conditions, Processes or Skills

The meteorological monitoring and data analysis program is subject to the requirements of *Quality Assurance Requirements and Description* (DOE 2002). The data produced in this program may be used to assess potential dispersion of radioactive materials from the licensed facility.

The work associated with the program is subject to the Integrated Safety Management Quality Assurance Program, Addendum 1 of *Quality Assurance Requirements and Description* (DOE 2002). Special quality assurance controls are not required for this activity. Two levels of personnel safety hazards and controls exist in the meteorological monitoring and analysis program. Standard office practices apply to work in the offices (in the field and in the Summerlin complex). The field monitoring work contains certain low risks associated with personnel working with tools and being exposed to environmental conditions. The risks associated with the field monitoring work are incorporated into line procedures according to integrated safety management principles and project guidance.

There are no prerequisites or special controls applicable to this program. The quality control and quality assurance activities associated with this program are adequate to assure the quality of the results and the technical product.

There are no special environmental conditions required for meteorological monitoring and data analysis activities, with one exception. Operational equipment and M&TE in long-term storage prior to activating the calibration period are in a secure, indoor location.

There are no special controls, processes, or skills required for meteorological monitoring and data analysis activities.

The meteorological monitoring and data analysis program includes the electronic storage and transfer of data. A process control evaluation (BSC 2002a) was performed in accordance with AP-SV.1Q, *Control of the Electronic Management of Information*, which showed satisfactory controls in place through the data handling line procedures.

9. Software

The EFPData software routine (BSC 2002b) imports the raw data files into a database by date and time according to data type and monitoring site. The routine also identifies missing data periods and “flags” (highlights the data to an operator) data that exceed expected threshold values. It also performs atmospheric humidity calculations to convert relative humidity to dew-point temperature. The routine is also used to edit the database during data validation, and the

edits are documented in a separate file. This routine was developed in accordance with AP-SI.1Q, *Software Management*.

Software is used to verify the correct transfer of electronic data. The checking is described in the line procedures controlling the data transfer operations.

The on-site data logger produces input files that are controlled within the routine operations line procedure.

10. Organizational Interfaces

No input to this work is provided by other organizations.

The meteorological monitoring results can be used to describe atmospheric dispersion and local meteorological conditions. These descriptions support the preclosure radiological safety analyses, engineering design of surface facilities, and performance assessment. Output of this work includes data listings contained in databases plus climatological and wind summaries.

The Test Coordination Office needs to know if at least one-inch of precipitation is recorded in a 24-hour period at Site 1 in Midway Valley. This information is required to determine impacts on testing activities that might occur from pooling of standing water. Meteorological site technicians monitor on-going weather conditions and visit Site 1 to determine if this event has occurred. If so, appropriate Test Coordination Office staff is notified.

The monitoring work includes procurements of equipment and services from outside vendors, and contracted independent "performance audits" accomplished to satisfy regulatory guidance. IAM personnel responsible for the M&TE procure the material and service using standard project procedures.

Meteorological site technicians, working in Area 25 of the Nevada Test Site, work in compliance with the Test Coordination Office and work to an approved work instruction. The work complies with procedures controlling work in that area.

11. References

11.1 Documents Cited

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BSC 2002b. *EFPData.* V.4.1.2. PC. 10420-4.1.2-01.

BSC 2003. *Field Activities in Support of Meteorological Programs.* FWP-SB-99-001, Rev 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. ACC: MOL.20030122.0036.

DOE (U.S. Department of Energy) 2002. *Quality Assurance Requirements and Description.* DOE/RW-0333P, Rev. 12. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020819.0387.

EPA (U.S. Environmental Protection Agency) 2000. *Meteorological Monitoring Guidance for Regulatory Modeling Applications.* EPA-454/R-00-005. Research Triangle Park, NC: U.S. Environmental Protection Agency. TIC: 253879.

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11.2 Codes, Standards, Regulations, and Procedures

ANSI/ANS-3.11-2000. *American National Standard for Determining Meteorological Information at Nuclear Facilities*. La Grange Park, Illinois: American Nuclear Society. TIC: 248540.

AP-12.1Q, Rev 0, ICN 2. *Control of Measuring and Test Equipment and Calibration Standards.* Las Vegas, NV: Bechtel SAIC Company, LLC. ACC: MOL.20020207.0111.

AP-SI.1Q, Rev. 4, ICN 0. *Software Management.* Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20030113.0149.

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ASTM D 5366-96. 1996. *Standard Test Method for Determining the Dynamic Performance of a Wind Vane.* West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 253820.

ASTM D 5741-96. 1998. *Standard Practice for Characterizing Surface Wind Using a Wind Vane and Rotating Anemometer.* West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 236772.

ASTM D 6176M-97. 1998. *Standard Practice for Measuring Surface Atmospheric Temperature with Electrical Resistance Temperature Sensors (Metric).* West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 253822.

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DOE Order 5400.1 Change 1. 1990. *General Environmental Protection Program.* Washington, D.C.: U.S. Department of Energy. Readily available.

LP-MM-001Q-BSC, Rev 0, ICN 1. *Tests and Checks of Meteorological Measuring and Test Equipment.* Las Vegas, NV: Bechtel SAIC Company, LLC. ACC: MOL.20020501.0390.

LP-MM-002Q-BSC, Rev 0, ICN 2. *Tests, Checks, and Performance Audits of Meteorological Equipment.* Las Vegas, NV: Bechtel SAIC Company, LLC. ACC: MOL.20020501.0393.

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ADDENDUM A

DETAIL ON THE METEOROLOGICAL MONITORING NETWORK

A1. INTRODUCTION

The meteorological monitoring portion of the program began with five stations in December 1985 as part of an environmental monitoring network. Four stations were added to the network during 1992, primarily in response to information needs for localized airflow characteristics related to the Exploratory Studies Facility. Five of the nine stations were downgraded to precipitation sites in 1999, with accompanying temperature and humidity measurements. Three more precipitation sites were added to the network in 1997 on top of the Yucca Mountain ridge. Information on the measurements and monitoring equipment follow the description of station locations.

A2. STATION LOCATIONS

Figure A-1 is a map showing the monitoring locations. Geographic information on the station locations is shown in Table A-1. Descriptions of the site exposures follow.

Site 1 (NTS-60) is located in the west-central portion of Midway Valley at an elevation of 1,143 m (3,750 ft) above mean sea level (msl). Site 1 is representative of the area of the proposed repository surface facilities.

Site 2 (Yucca Mountain) is on the Yucca Mountain ridge crest, toward the north end of the ridge. Site 2 is 4 km west-northwest of Site 1, at an elevation of 1,478 m (4,850 ft) msl.

Site 3 (Coyote Wash) is in a narrow wash typical of the east side of the Yucca Mountain, at an elevation of 1,279 m (4,195 ft) msl. Site 3 is 1.6 km east of the Yucca Mountain site.

Site 4 (Alice Hill) is located on top of a sloping hill 3.4 km northeast of Site 1 (Alice Hill), at an elevation of 1,234 m (4,050 ft) msl. The elevated location of Alice Hill is advantageous for observing meteorological conditions aloft in Midway Valley.

Site 5 (Fortymile Wash) is in southern Jackass Flats on the east side of Fortymile Wash, southeast of Busted Butte. Site 5 is 9.4 km southeast of Site 1, at an elevation of 953 m (3,125 ft) msl. This location is on an airborne transport pathway between the proposed repository surface facility and the Amargosa Valley populated area.

Site 6 (WT-6) is at the WT-6 exploratory well pad, in the upper end of Yucca Wash, near the boundary line between the Nevada Test Site and the Nellis Air Force Range land. Site 6 is 6.1 km north-northwest of Site 1, at an elevation of 1,315 m (4,315 ft) msl.

Site 7 (Sever Wash) is in the topographic gap between Alice Hill and Fran Ridge, 2.1 km east-northeast of Site 1, at an elevation of 1,081 m (3,545 ft) msl. This location is along the surface-level nocturnal drainage airflow path out of Midway Valley.

Site 8 (Knothead Gap) is in a topographic saddle east of Bow Ridge, in the southern end of Midway Valley, and is 1.7 km south-southwest of Site 1, at an elevation of 1,131 m (3,710 ft) msl. This location is one kilometer east of the South Portal of the Exploratory Studies Facility.

Site 9 (Gate 510) is on the southern border of the Nevada Test Site, 3 km north of the commercial area on highway U.S. 95 in Amargosa Valley. Site 9 is 19 km south-southeast of Site 1, and 10.4 km south of Site 5, at an elevation of 838 m (2,750 ft) msl.

Site 401 (Bleach Bone Ridge) is on the northern end of the ridge on top of Yucca Mountain at an elevation of 1,562 m (5,125 ft) msl. It is about 5.7 kilometers northwest of Site 1, overlooking upper Yucca Wash.

Site 405 (Yucca Mt – WX4b) is about the center the ridge on top of Yucca Mountain at an elevation of 1,488 m (4,882 ft) msl. It is about 2.2 kilometers west-southwest of Site 1.

Site 415 (Yucca Mt SE or E of G-3) is further south along the ridge on top of Yucca Mountain, east of a small saddle separating the ridge top from the hill overlooking Abandoned Wash. It is at an elevation of 1,440 m (4,725 ft) msl, and is about 2.7 kilometers southwest of Site 1.

A3. MONITORING EQUIPMENT

Site 1 includes a 60-m tall tower, instrumented at two levels with wind and temperature sensors 10 and 60 m above ground level (m-agl). Horizontal wind speed and direction are measured at both levels, and vertical wind speed is measured at 10 m-agl. Temperature, relative humidity, and solar radiation sensors are located at 2 m-agl, and barometric pressure is nominally located at the surface.

All sites have two precipitation gauges. One gauge records by increments of 0.01-inch; the other gauge is a standard storage gauge. The recording gauge at Site 1 is heated to capture snowfall as it occurs.

Sites 2, 4 and 9 include towers instrumented at 10 m-agl with wind and temperature sensors virtually the same as those at Site 1 (except those at 60 m-agl), and the remaining other measurements. Sites 3, 5, 6, 7, and 8 have temperature and relative humidity sensors at 2 m-agl. Site 5 also includes a barometer. Sites 401, 405 and 415 have precipitation gauges.

Table A-1. Coordinates of the Meteorological Monitoring Sites

Site	UTM Coordinates Zone 11 (meters)	Nevada System (feet)	Latitude-Longitude[1] (deg° min' sec")	Elevation (msl)[2]
Site 1	550,784E	569,126E	36° 50' 34"N	3750 ft
(NTS-60)	4,077,374N	761,795N	116° 25' 50"W	1143 m
Site 2	547,646E	558,844E	36° 51' 19"N	4850 ft
(Yucca Mountain)	4,078,753N	766,356N	116° 27' 56"W	1478 m
Site 3	548,874E	562,874E	36° 51' 17"N	4195 ft
(Coyote Wash)	4,078,701N	766,171N	116° 27' 06"W	1279 m
Site 4	553,117E	576,810E	36° 51' 51"N	4050 ft
(Alice Hill)	4,079,779N	769,661N	116° 24' 15"W	1234 m
Site 5	554,385E	580,843E	36° 45' 52"N	3125 ft
(Fortymile Wash)	4,068,727N	733,378N	116° 23' 26"W	953 m
Site 6	549,388E	564,612E	36° 53' 40"N	4315 ft
(WT-6)	4,083,097N	780,592N	116° 26' 45"W	1315 m
Site 7	552,800E	575,747E	36° 50' 49"N	3545 ft
(Sever Wash)	4,077,847N	763,324N	116° 24' 28"W	1081 m
Site 8	551,161E	570,344E	36° 49' 42"N	3710 ft
(Knothead Gap)	4,075,773N	756,538N	116° 25' 35"W	1131 m
Site 9	553,418E	577,554E	36° 40' 17"N	2750 ft
(G-510)	4,058,398N	699,491N	116° 24' 08"W	838 m
Site 401	547,995E		36° 53' 16"N	5125 ft
(Bleach Bone Ridge)	4,082,387N		116° 27' 42"W	1562 m
Site 405	546,718E		36° 49' 50"N	4882 ft
(Yucca Mt – WX4b)	4,076,063N		116° 28' 03"W	1488 m
Site 415	548,091E		36° 48' 47"N	4725 ft
(Yucca Mt SE,	4,074,129N		116° 27' 39"W	1440 m
E of G-3)				

Notes: [1]NAD27 (North American Datum of 1927)
[2]msl: above mean sea level

Table A-2. Accuracy

Measurement	Calibration Tolerance	Performance Check and Performance Audit Tolerance
Wind Direction Starting threshold	±3 degrees <0.447 m/s (0.5 mph) at 10°	±5 degrees Torque limits (gm-cm): Climatronics 100076: 6.0 MetOne 1564B: 2.5
Wind Speed (horizontal and vertical) Starting threshold	≤ 5 m/s: ±0.25 m/s > 5 m/s: ±5% of observed <0.447 m/s (0.5 mph)	Same Same Torque limits (gm-cm): Climatronics 100075: 0.3 MetOne 1565C: 0.25 Climatronics 102236: 0.75
Temperature	±0.5 degrees	Same
Delta-temperature	±0.1 degrees	Same
Precipitation Recording gauge Manual storage gauge	Orifice: ±0.75-inch diameter Volume: ±10%, Count: exact Measure: ±10%	Same Same N/A
Barometric pressure	±3 millibars	Same
Relative humidity	< ±1.5 C dew point	RH ≤ 40%: ±4 % RH > 40%: see calibration
Solar radiation Zero check Measurement	 ±10 W/m^2 ±5%	 Same N/A

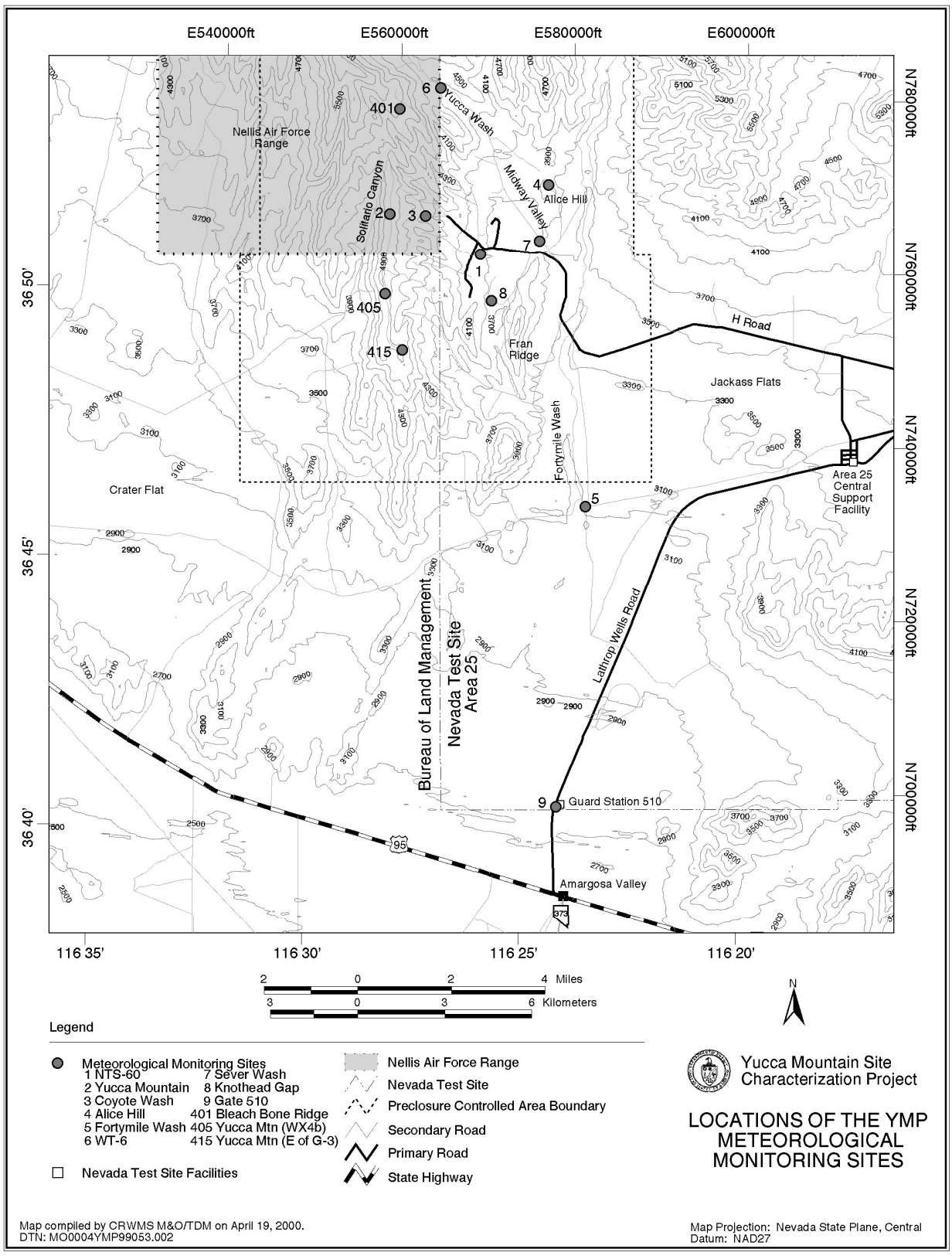

Figure A-1. Locations of the Yucca Mountain Project Meteorological Monitoring Sites